



REMR Technical Note OM-MS-1.3 (Supersedes OM-MS-1.3 1991)

REMR Management System for Miter Lock Gates

Purpose

This technical note provides information about the REMR Management System for miter lock gates.

Background

The U.S. Army Corps of Engineers is responsible for maintaining a large number of lock and navigation facilities. To assist those involved in planning and budgeting for maintenance and rehabilitation (M&R) of these facilities, a series of REMR Management Systems is being developed. These computerized maintenance management systems should provide improved and more consistent methods for life-cycle cost comparisons of M&R alternatives and a more effective means for monitoring the condition of facilities (see REMR Technical Note OM-MS-1.1).

Overview

A REMR Management System has been developed for miter lock gates. Like the other REMR Management Systems, this one contains standardized inspection and condition rating procedures, life-cycle cost-analysis routines, and data storage and handling capabilities. The system also includes software for performing required calculations and for producing a variety of reports for work planning and budgeting purposes.

As with the other REMR Management Systems, the primary driving element is the condition rating process. The condition ratings used in this system follow the standard REMR condition index (CI) scale, as described in REMR Technical Note OM-CI-1.2.

Application of this management system begins with an inspection of a miter gate according to the standard procedure established for the system. This inspection information is entered into the system to determine the functional CI, the structural CI, and finally, an overall CI for the whole gate.

Next, various alternatives are formulated into a set of M&R solutions. The program will then provide consequences for these alternatives and perform a life-cycle cost analysis for each. This process is illustrated in Figure 1.

Condition Index

The CI is a numerical measure of the current state of a structure. It is part of the goal of this project to define a CI that uniformly and consistently describes and ranks the condition of miter lock gate structures. The CI is primarily a planning tool, with the index values serving as an indicator of the general condition level of the structure. The index is meant to focus management attention on those structures most likely to warrant immediate repair or further evaluation. In addition, the CI values can be used to monitor change in general condition over time and can serve as an approximate comparison of the condition of different structures. The REMR CI is a numbered scale, from a low of 0 to a high of 100. The numbers indicate the relative need to perform REMR work because of deterioration of the functional and structural characteristics of the structure. For more information and background on the CI, refer to REMR Technical Note OM-CI-1.2, "The REMR Condition Index: Condition Assessment for Maintenance Management of Civil works Facilities."

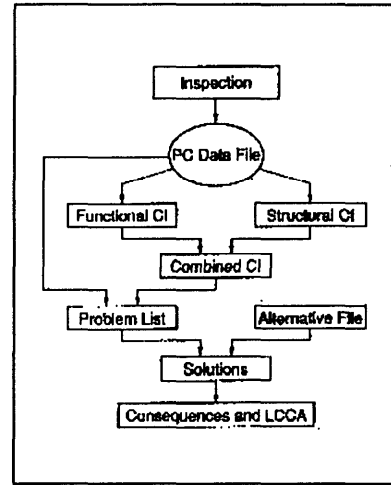


Figure 1. M&R analysis of miter lock gates

Functional CI

The functional CI is based on field measurements and observations of structure defects. The functional CI includes both safety and serviceability considerations. A series of critical measurements are made on each gate to quantify the functional CI. These measurements are related to a list of 10 functional distresses listed in Table 1. As an example, a movement, X , of 0.002 in. could be measured at an anchorage system. If the limiting value of this movement, X_{max} , is 00.004 in. ($X/X_{max} = 0.5$), observation of Figure 2 gives a functional CI near 63. This is a Zone 2 condition in which an economic analysis of different repair alternatives is recommended. A similar procedure is used for the other distresses shown in Table 1. The functional CIs for the individual distresses are combined, using a weighted average to give the overall functional condition of the gate.

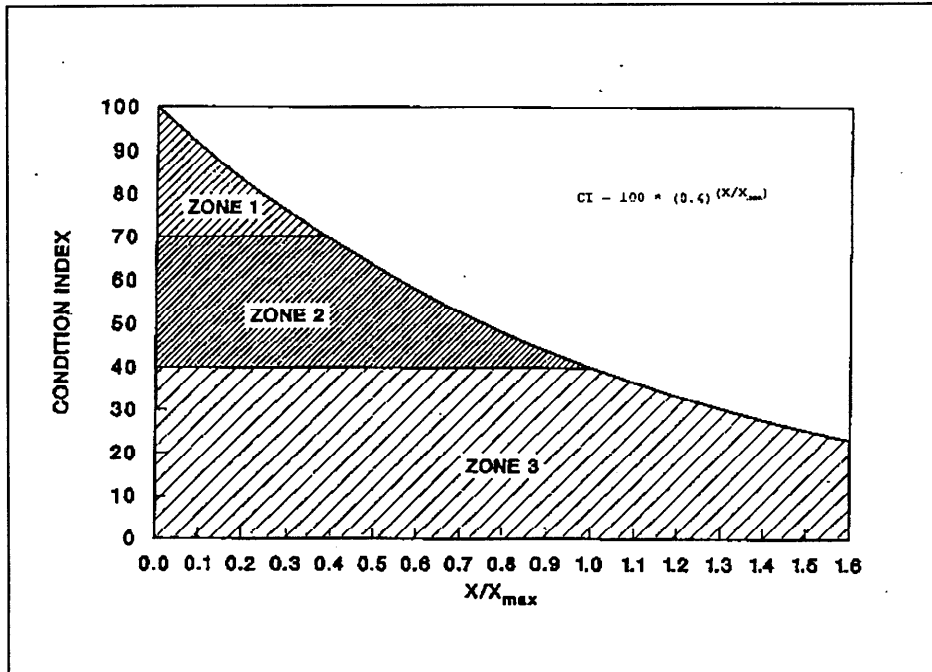


Figure 2. Functional CI related to X/X_{max}

Structural CI

The structural CI is a measure of the safety of the structure or its risk of failure. It is based upon the calculation of a factor of safety (FS) of the existing state of the structure, taking into consideration a factor such as corrosion. A basic part of the structural safety evaluation is a structural analysis. The U.S. Army Corps of Engineers' design manuals serve as the basis for the analysis procedure of miter lock gates. These sources are supplemented by the U.S. Army Corps of Engineers' computer program, CMITER, which performs a structural analysis of the horizontally framed gate. As an example, if the actual FS of a component were greater than its design FS (2.0 for normal load cases), the structural CI would be 100. As the actual FS approaches 1, the structural CI becomes 39, a Zone 3 condition recommending further evaluation and eventual repair.

M&R Analysis

The structural and functional problems detract from the performance (safety and/or serviceability) of the structure. After the problems have been identified, several different M&R solutions can be formulated. The consequences of each strategy are obtained by calculating a new CI that reflects the as-repaired structure. Life-cycle cost information about the solution can then provide a preliminary evaluation of a maintenance plan.

Table 1 Distresses In Miter Lock Gates		
Distress Code	Distress	Brief Description
1	Top anchorage movement	Motion of the upper anchorage system during gate operation
2	Elevation change	Vertical displacement of the gate during operation
3	Miter offset	Misalignment of the bearing blocks at the miter point
4	Bearing gaps	Gaps between the bearing blocks at the quoin and miter
5	Downstream movement	Downstream displacement of the miter point as the head is applied
6	Cracks	Breaks in the structural steel components
7	Leaks/boils	Water passing through or around the gate
8	Dents	Disfiguration of the steel components
9	Noise/vibration	Abnormal noise, vibration, or jumping during gate operation
10	Corrosion	Loss of steel due to interaction with the environment

Reference

Greimann, L., Stecker, J., and Rens, K. (1990). "Inspection and Rating of Miter Lock Gates," Technical Report REMR-OM-7, U.S. Army Construction Engineering Research Laboratories, Champaign, IL.